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Compact ADOV Routing and the Bat Algorithm for Advanced Route Optimization in MANET

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Abstract - The MANET is described as a wireless dynamic topology network. It doesn't have a centralized unit to control the other nodes and nodes are configured within the network.The trust route is very challenging issues in the network. The available routes are not sure to complete this data transmission task perfectly due to the dynamic topology and less centralized configuration. This reduces network performance such as packet drop or incomplete data transmission. In this paper, the Enhanced Route optimization techniques are introduced with the support of the Bat Algorithm (EROiBA) in MANET. This technique creates the trust and best route from source to destination. In fact, trust and the best routes are selected by the node iteration condition and the average total energy level of the nodes between the sources to destination. The iteration of the sender node is a detail of the previous performance ratio of the adjacent node evaluated by the source node. The EROiBAis simulated in ns-2 tools and observesthisoutcome such as packet delivery ratio, end-to-end delay and throughput. The result of the EROiBA is improved over existing work.

Keyword - AODV, Bat Algorithm, Trust condition, Energy of the node

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INTRODUCTION

The Mobile Ad-hoc network is a wireless network and nodes are not pre-defined linkswith each other. Nodes are dynamically connected without any pre planed and are controlling itself without any centralized unit. Therefore the connecting the nodes, disconnecting and reconnecting again after a certain time delay, they are the working part of the network. Creatingfixed route is very complicated within the network due to dynamic topology. So, the route discovery process is initiated when it is needed. The process is started by route request, it is sent by sources and forward to another node multi-hop concept.This process, taking into account several routes to reach the destination. But, the available routes are unreliable to transfer the packet to the destination. In this case, the best route and trust routes are more important to forward the packet. The route is not trusted, so we have to deal with a different problem like losing packets while transferring multiple packet. At the same time network traffic due to less bandwidth of the medium increases the delay and routing overhead. Already the solution has given to this problem by the advanced scope of several existing algorithms.

The meta-heuristics algorithm is a recent development of search methods to address optimization problems in the wireless Ad-hoc network. This technique is enhanced throughArtificialIntelligence, biological, natural and physical science.

The Swarm Intelligence is a biological Meta-heuristics algorithm. In this algorithm agent following the simple condition, it is how single agent must behave, locate the area, interactions with other agents. It is suitable for a less centralized network and dynamic topology. The example for swam intelligence in natural system are ant colonies, bee colonies, bird flocking, Bat algorithm etc.,

The bat algorithm is a method of swarm intelligence. This is one of the optimization techniques to resolve the problem and produces a better solution in various applications. In this work, the best route between the source and destination is selected by Bat optimization method and improved the performance of the Mobile Ad-hoc network.

The micro bats are identified the prey by echolocation activity. The flying bat propagates the sound in the forward directionat short frequency

and identifies the atmosphere. The forwarded sound signal is bounced by any one of the objects in front of flying bats.This echo signal is heard by bats and imagines the object by echo signal strength.In this work, the following conditions are appliedto the bat algorithm in order to optimize the best route. Such as position of the node (pray), frequency(Request Packet), velocity, Loudness (trust value) and pulse width (time delay and node Energy). The randomly moving bat is emits a Request packet with a constant velocity. If any prey is found, this pray node is given echoto the source. Afterword, the bat adjusts the loudness and pulse width (send the control packet in this same way) and identifies theefficiency of this route.

Additionally, with in introduction the paper contains the following section, such as section 2- the recent relevant work of swarm intelligent optimization, section -3 is a proposed work of Bat algorithm, section-4 is a simulation result of this work and section-5 is the conclusion of this work.

RELATED WORK OF SWARM INTELLIGENT OPTIMIZATION

The Swarms Best existing work intelligent optimization techniques are discussed below along merits and demerits. This existing works assists in making this paper effective.

The paper proposed[1] the hybrid bat algorithm using the ELM [Extreme Learning Algorithm] approach to detect ID spoofing in the nodes. Infected nodes are easily identified through repeated sample learning and have a better result. But valid packetsmay be dropped off when this packet is travelling on the same route.

The author proposed[2] the application of the bat algorithm to the transport network design problem. This willreduces the network congestion and reduced the traffic. The network traffic is controlled by the bilevel model. In the worst case scenario, the objective solution is reduced by increasing the network nodes.

The paper proposed [3] the Enhancement of BAT Algorithm using the Diversity function for Routing optimization in WSN. The energy of the node is evaluated in thenetwork and has improved the energy utilization for a long period. The overallperformance of the network is higher than previous work. But in the multi-link state the time delay is increased as a result of network traffic.

The work is implemented [4] by Ant colony swarm intelligence method and selected the Optimized Trust Path to reach the destination and control the packet drop and collusion. But the network routing overhead is increases exponentially asunder the condition of increasing the size of the network.

The author proposed[5] QoS multicast routing for wireless mesh network based on a modified binary bat algorithm. The modified binary bat algorithm is used to solve the routing problem such as delay, jitter, bandwidth and packet loss rate to get a low-cost multicast tree.

The proposed work of[6] the Intrusion Detection for Mobile Ad Hoc Networks Based on Node Reputation. The selfish node is detected by monitoring the module, reputation evaluation and penalty module. The results of this work are considered selfish attack only.

The author proposed[7] Bat optimized link state routing protocol for energy-aware mobile ad-hoc networks. The result of PDR, EC, ROR and E2E delays improves compared with a basic OLSR protocol algorithm. But network security does not considered. So it is very easily attacked by vulnerable nodes in the network.

In this efficient Bat algorithm for node localization in distributed wireless sensor network[8], the localization position of a node is easily identified at low cost. The evaluation process is constructedby the velocity of the batsmeasured by hybridization with Doppler effect. But, the energy utilization is not included in this work.

In Nature inspired route optimization in vehicular Adhocnetwork [9], the optimized route is designed by bat algorithm with 3 conditions, they are destination prediction, evaluate the invalid node and finally selected optimized route. The results of this algorithm working effectively with less time. But it is suitable for small size of the network, otherwise the delayhas increased by increasing the scalability of the network.

PROPOSED METHOD

The swarm intelligence based Bat algorithm is an optimization technique to solve the problem and produces a better solution in various applications.In this work, the MANET routing protocols are improved by the techniques of optimizing bats in Figure1.The MANET is a self-configured dynamic topology and nodes moves randomly. However, moving source nodes act as a Bats is forwarding the request (Req) packet to all the adjacent nodes in Figure2. The receiving nodes are a destination. It is giveneco (reply) to the source to stop the Req Packet further forwarding in Figure3.If it is not a destination, update the details of those nodes and transfer Req to the next adjacent node.The source is after receiving the eco signal, it sends the control packet to the destination along the same path. Next, measure the trust value based on number of iterations (Loudness), which is previous number of visits on the node and Pulse width. The Pulse widthof the route is considered theTimedelay and Energy of the node.

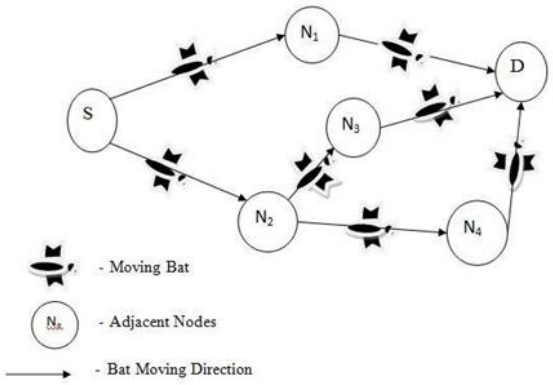

Figure 1-Bat Moving and Adjacent nodes

Request Time Start	SrID	DestID	Updates of Previous nodes	Next node IDin register	Hop Count

Figure 2 – Req Packet

Reply Time Start	Dest ID	SrID	Updates of Previous nodes	Next node ID in register	Hop Count

Figure 3- eco Packet

Initially, bats frequently forwarding the Request packets from the source toa next adjacent node with a constant interval (velocity).Theprey (destination) is received the request is reply with echo packets. The source continually sends the control package to the adjacent node.The control packet is collect the trust value of the route and Pulse width. The Pulse width is measured by the delay and Energy utilization of the route. Otherwise,the adjacent node is forward theReq same to the next adjacent node. The source node is identified the detail of adjacent node by the echosignal.This Forwarding Request is moving to a next adjacent node with updates of the current timestamp. The Req forwarding adjacent nodes are conforming that work by the echo after reaching the packet to the destination in Figure 4 and 5.

SrID	Dest ID	Time	Req of Iteration	Req Energy of the nodes

Figure 4 – ReqCont packet

Dest ID	SrID	Delay time	number of Iteration	Node Energy

Figure 5 – RepCont packet

The source or sender node is started to forward the Request batto identifythe preyto the moving path. The total average number of bats between sources to destination is calculated by in equation 1.

$$X_n = \sum_{i=1}^{n} \sum_{j=1}^{m} x_{ij} / N \qquad -1$$

Where, X_{ij} is a bats between source to directly connected destination or adjacent nodes. The number of average bats to research the destination is X_n. It is equal to hop count between the source to destination.

In the MANET, nodes are arranged in different locations randomly and at variable distance.The distance to the destination is measured based on the time it takes to reach the source. Initially, time (Tij) is taken to reach source node to adjacent nodes is considered as the ratio of displacement between (xj – xi) and (tj – ti) in equation 2

$$T_{ij} = (X_j - X_i) / (t_j - t_i) \qquad -2$$

Thus the total time required to reach from source to destination in equation 3,

$$T = \sum_{i=1}^{n} (T_{ij}^{n}) \qquad -3$$

The Total Energy required to reach the information from source node to destination is evaluated by equation 4,

$$ET = \sum^{n} (E_{ij}) \qquad i=1 \qquad -4$$

Where each node energy is considered as Eij = Previous Energy – utilized Energy

The bat optimized route is selected by the Req packet send by bat nodes, Loudness and pulse rate of the bat. The Loudness(trust) is a sender node already visited count of that adjacent node. The pulse rate is measured by the sum of time delay and Energy utilization of the route.

An algorithm for Optimized best Route using Bat

1. Initialize the ‘n’ number of Bat nodes ‘Xi’
2. Request Packet ‘ Req’
3. Reply Packet ‘eco’
4. Loudness = Trust measured by the number of iterations
5. Pulse rate = T and ETis measured by time delay and Energyof the route

6. Control Packet 'ReqCont'
7. Control Packet 'RepCont'
8. Source node 'Xs' start to send the Request 'Req' to adjacent node
9. If Xj is a Destination then
10. Xj reply the eco signal
11. If XsReceived the eco, then
12. Xs is sending ReqCont to Xj
13. Xj accept the Reqcont
14. If (Trust >LoudnessThreshold&&Pulse rate>T), then
15. Updated the route details
16. Selected as optimized best route
17. Else the selected route is rejected by source with updates
18. Else, Resend the Req to adjacent node
19. Else Xjgiven eco to Xsand repeat the step.8

SIMULATION RESULTS

The simulation of this work is implemented into ns2 simulation tools with 150 nodes. The ns2 is the best tool to analyze the network performance in wired and wireless mode. The ns2 support various wireless network routing protocols such as TCP, UDP, AODV, DSR, etc., The nodes are configured before the simulation, which details as shown in the Table1 below.

Table 1. Simulation Parameters

Simulation Parameter	Value
Simulator	Ns-2
Number of nodes	150
Simulation Time	100s
MAC Protocol	IEEE 802.11b
Data Rate	54 Mbps
Radio Range	250m
Mobility model	Random Way point model
Antenna	Omni directional Antenna
Packet size	546 bytes

In this simulation, nodes move erratically with no restrictions in the network area. The sender node is sends the request to the neighboring nodes based on bat technology and estimate the route value based on time delay, energy of the nodes and previous performance of the adjacent nodes. Finally the result is measured in relation to the Packet delivery ratio, End to End delay and Throughput with the previous algorithm.

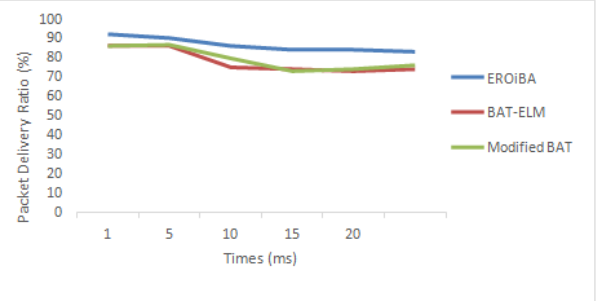

Figure 6 – Packet Delivery Ratio Vs Time

The result of the EROiBA is compared with the existing algorithm of BAT-ELM[1] and the modified BAT[3] is shown in Figure.6. The graph shows the Packet delivery Ratio with respect to time. The result of the EROiBA is diminished due to the growing time to reach the source to destination. But when compared with existing algorithm the overall results are improved.

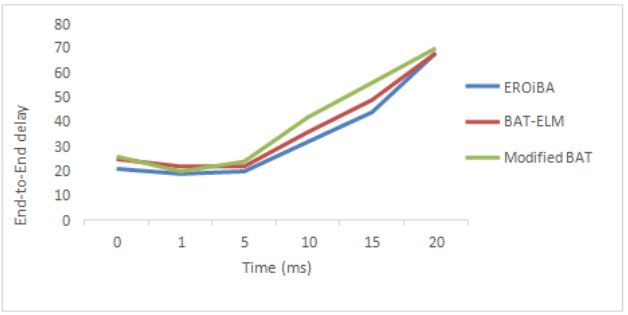

Figure 7 – End to End Delay Vs Time

The End to End delay is defined as the ratio of the sum of the received packet time – sum of the sending packet time / Total number hop counts. The graph in Figure-7, theresults of the end to end delay considered in relation to the time to reach the packet from the sources to destination. The overall results of EROiBA are better compared with other existing algorithms.

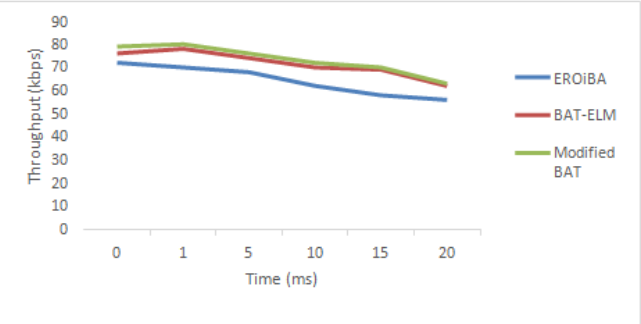

Figure 8 – Throughput VsTime

The result of EROiBA is given in Figure-8, the graph is considered with respect to throughput Vs time. The throughput is defined as the total packet size at transmission time to reach the destination. The result of this work has produced better results in comparison with other existing work.

CONCLUSION

In this work, Enhanced Route optimization[EROiBA] technique is implemented using the Bat Algorithm. This method is used to track the trust and best route to reachthe destination and reduced the packet drop and packet transmission delay.The bat is evaluated according to the condition of the iteration recordings of adjacent nodes in each node, the time and the total average energy to reach the destination. The result of packet delivery ratio, end to end delay and throughput is compared with existing algorithm of BAT-ELM and Modified Bat. Finally observed the result of EROiBA is an increase in efficiency measures compared with existing methods.In the future, attacks are introduced into the network to enhance the performance measures of this algorithm.

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